IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No:	10/511,622
Applicants:	Masayuki Orihashi et al.
Filed:	October 18, 2004
Title:	COMMUNICATION APPARATUS AND COMMUNICATION METHOD UTILIZING MULTIPLE CARRIER WAVES FOR OVERCOMING INTERFERENCE (AS AMENDED)
T.C./A.U.:	2617
Examiner:	Christopher M. Brandt
Confirmation No.:	4055
Docket No.:	MAT-8605US

AMENDMENT UNDER 37 C.F.R. § 1.116

Expedited Procedure

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Responsive to the Final Office Action dated July 25, 2008, please amend the above-identified application as follows:

☒ **Amendments to the Specification** begin on page **2** of this paper.

☒ **Amendments to the Claims** are reflected in the listing of claims which begins on page **3** of this paper.

☐ **Amendments to the Drawings** begin on page of this paper and include an attached replacement sheet(s).

☐ **Amendments to the Abstract** are on page of this paper. A clean version of the Abstract is on page of this paper.

☒ **Remarks/Arguments** begin on page **8** of this paper.

Amendments to the Specification:

Please replace the paragraph, beginning at page 15, line 20, with the following rewritten paragraph:

The modulator 204 inputs transmission data, and impulse-modulates it according to a predetermined procedure. Impulse modulation is known including pulse-position modulation that is to superimpose information over pulse time interval, pulse-phase modulation that is to superimpose information over pulse phase, and pulse-amplitude modulation that is to superimpose information over pulse amplitude. In this manner, an impulse modulation wave is generated corresponding to transmission data, to output a subcarrier modulation signals in an amount of a predetermined number of subcarriers. The ~~subscribers~~ subcarriers are attached with the same symbol. The subcarrier modulation signals are inputted to the transmission sections 205, to be output as power-amplified subcarrier transmission signals therefrom. The power-amplified subcarrier transmission signals are inputted to the filter section 250 and band-limited by the corresponding filters 201. The impulse modulation signal has a feature having a much-broadened band because it is an impulse-natured signal. Consequently, there is a feature that, even when passed through a narrower-banded filter having a different center frequency, there exists a corresponding frequency component. Thus, output is obtainable in accordance with a filter. Namely, the transmission signal outputted from the filter section 250 is such a signal as having a frequency characteristic shown in Fig. 3, in a state multiplexed with a plurality of subcarrier signals 201 to 207. The transmission signal is supplied to the antenna section 101, to radiate an electromagnetic wave by the radiation characteristic thereof.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application

Listing of Claims:

1. (Currently Amended) A communication apparatus comprising:

a modulation part for ~~impulse-modulating transmission data and~~ generating a plurality of subcarriers modulation signals, at least two of the subcarriers including the same data, using an impulse modulation signal generated by impulse-modulating transmission data;

a transmission part for amplifying the plurality of subcarriers modulation signals and generating a plurality of subcarrier-transmission signals;

a filter section for outputting a plurality of transmission signals in a frequency range of the frequency band of the impulse modulation signal, the transmission signals being band-limited of the plurality of subcarrier-transmission signals; and

an antenna section for multiplexing and radiating the plurality of transmission signals.

2. (Previously Presented) A communication apparatus according to claim 35, further comprising a reception modulation part for detecting reception data and examining a reception power on each subcarrier,

to notify to the subcarrier control section a permission/non-permission to use the subcarrier, depending upon the reception power examined by the reception demodulation part.

3. (Original) A communication apparatus according to claim 2, wherein the carrier control section causes hopping two or more of the subcarriers.

4. (Original) A communication apparatus according to claim 2, wherein the carrier control section causes spread on two or more of the subcarriers.

5. (Previously Presented) A communication apparatus according to claim 1, wherein the modulation part changes an on-frequency allocation of the subcarriers according to communication condition.

6. (Previously Presented) A communication apparatus according to claim 1, wherein the modulation part assigns a narrower band to the subcarrier having a lower center frequency and a broader band to the subcarrier having a higher center frequency.

7. (Previously Presented) A communication apparatus according to claim 1, further comprising a channel control section for selecting and controlling the subcarrier for use on each channel,

the channel control section performing communication over two or more channels with different ones of the subcarriers.

8. (Original) A communication apparatus according to claim 7, wherein the channel control section performs communication over two or more channels with a combination of different ones of the subcarriers.

9. (Previously Presented) A communication apparatus according to claim 35, wherein carrier control part performs communication of control information by at least one of the subcarriers.

10. (Previously Presented) A communication apparatus according to claim 9, wherein the modulation section multiplexes together the pieces of control information on three or more channels by use of any one of time division multiplex and code division multiplex, in at least one subcarrier of two or more of the subcarriers.

11. (Previously Presented) A communication apparatus according to claim 2, wherein the modulation section carries out frequency division duplex by use of two or more of the subcarriers.

12. (Previously Presented) A communication apparatus according to claim 9, wherein the modulation section carries out frequency division duplex by use of three or more of the subcarriers.

13. (Previously Presented) A communication apparatus according to claim 9, wherein the subcarrier with which the modulation part is to communicate the control information has a center frequency lower than a center frequency of the other subcarrier.

14. (Previously Presented) A communication apparatus according to claim 9, wherein the subcarrier with which the modulation part is to communicate the control information has a band narrower than a band of the other subcarrier.

15. (Previously Presented) A communication apparatus according to claim 7, wherein the modulation part divides one symbol into two or more of the subcarriers, thereby multiplexing two or more channels.

16. (Previously Presented) A communication apparatus according to claim 15, wherein the modulation part causes frequency hopping in one symbol by use of two or more of the subcarriers, to thereby multiplexing two or more channels.

17. (Previously Presented) A communication apparatus according to claim 15, wherein the modulation part causes encoded spread of one symbol onto two or more of the subcarriers, to thereby multiplexing two or more channels.

18. (Previously Presented) A communication apparatus according to claim 15, wherein the modulation part causes spread of one symbol onto two or more of the subcarriers and two or more chips, thereby multiplexing two or more channels.

19. (Previously Presented) A communication apparatus according to claim 1, wherein the antenna part comprises a plurality of antenna elements.

20. (Previously Presented) A communication apparatus according to claim 1, wherein the antenna part has a frequency characteristic of a multi-band characteristic.

21. (Original) A communication apparatus according to claim 19, wherein the antenna elements are different in center frequency of frequency characteristic.

22. (Original) A communication apparatus according to claim 21, wherein the antenna elements have band characteristics not to overlap on a frequency axis.

23. (Previously Presented) A communication apparatus according to claim 2, wherein the antenna part receives radio wave on a subcarrier-by-subcarrier basis and outputs the subcarrier signal to the reception modulation part.

24. (Original) A communication apparatus according to claim 19, wherein the antenna elements have frequency characteristics corresponding to the subcarriers and radiate subcarrier transmission signal as a radio wave.

25. (Previously Presented) A communication apparatus according to claim 2, wherein the reception demodulation part has a compensation part for detecting a characteristic of a subcarrier-based signal sub-system from a known signal received from a communication partner and compensating for the characteristic of the signal sub-system.

26. (Previously Presented) A communication apparatus according to claim 25, wherein the characteristic of the signal sub-system is a frequency characteristic.

27. (Previously Presented) A communication apparatus according to claim 25, wherein the characteristic of the signal sub-system is a time response characteristic, the compensation part compensating for the time response characteristic by a correlation signal of a correlator.

28. (Previously Presented) A communication apparatus according to claim 2, wherein the reception demodulation part comprises

a spread code storing part for storing a spread code and extracting a spread code corresponding to the subcarrier, and

a dispread part for making a convolution operation of the subcarrier signal and the spread code extracted at the spread code storing section.

29. (Previously Presented) A communication apparatus according to claim 1, wherein the transmission demodulation part comprises

a spread code storing part for storing a spread code and extracting a spread code corresponding to the subcarrier, and

a spread part for making a direct spread onto the subcarrier from the modulation signal divided into the subcarriers and the spread code extracted at the spread code storing part.

30. (Previously Presented) A communication apparatus according to claim 2, wherein the reception demodulation part comprises

a switch part for switching over by frequency hopping on the subcarrier,

the carrier control part carrying out the control in the switch part.

31. (Previously Presented) A communication apparatus according to claim 1, wherein the demodulation part comprises

a switch part for switching over by frequency hopping on the subcarrier,

the carrier control part carrying out the control in the switch section.

32. (Currently Amended) A communication method for impulse modulation communication with using a plurality of subcarriers in a frequency range of the frequency band of an impulse modulation signal, at least two of the subcarriers including the same data, the communication method comprising:

a step of measuring a reception power on every subcarrier in a non-signal state, in an initial state prior to starting a communication; and a step of determining the reception power measured and selecting the subcarrier usable in communication.

33. (Original) A communication method according to claim 32, wherein the determination is to use, in a later communication, the subcarrier having the reception power equal to or smaller than a predetermined value.

34. (Original) A communication method according to claim 33, further comprising

a step of measuring a reception power on every subcarrier of a received known signal at a start of communication; and

a step of selecting the subcarrier having the measured reception power equal to or greater than a predetermined value, as a subcarrier usable in communication.

35. (Previously Presented) A communication apparatus according to claim 1, further comprising a carrier control part for controlling the subcarriers for use in communication depending upon information amount, significance and communication propagation condition.

Remarks/Arguments:

The present invention relates to a technique for impulse communication. Specifically, multiple narrow band subcarrier signals are multiplexed in frequency in a frequency range of the impulse modulated signal.

On page 2, the Official Action rejects claim 1 under 35 U.S.C. 112 as failing to comply with the written description requirement. The Examiner states that the recitation of "*at least two of the subcarriers including the same data*" is not supported in the specification. Applicants, however, respectfully disagree. This feature is supported on page 15, lines 19 and 20 of the specification ("*the subscribers are attached with the same symbol*"). The portion of the specification which recites "subscribers" is a typo, and should actually read "subcarriers." Support for this typo is found in Applicants' PCT application. Thus, Applicants have amended page 15 of the specification accordingly. No new matter has been added.

On page 3, the Official Action rejects claim 1 under 35 U.S.C. 112 as being indefinite. Specifically, the Examiner states that the recitation of "transmission" in line 14 of claim 1 should recite "transmission signals." Applicants agree with the Examiner, and have amended claim 1 as suggested.

On page 4, the Official Action rejects claims 1, 6-8, 15-22, 24, 29 and 31 under 35 U.S.C. 103(a) as being unpatentable over Fullerton (U.S. Patent No. 5,677,927) in view of Rouquette (U.S. Patent No. 7,308,035). It is respectfully submitted, however, that the claims are patentable over the art of record for at least the reasons set forth below.

Fullerton teaches an ultrawide-band communication system by utilizing subcarriers in an impulse modulation system. Specifically, the subcarriers are separated into individual independent channels. Rouquette teaches a diversity transmission system that comprises multiple antennas. Specifically, Rouquette transmits data over different bands at different points in time.

Applicants' invention, as recited by claim 1, includes a feature which is neither disclosed nor suggested by the art of record, namely:

> **...a modulation part for generating a plurality of subcarriers modulation signals, at least two of the subcarriers including the same data, using an impulse modulation signal...**

...a filter section for outputting a plurality of transmission signals in a frequency range of the frequency band of the impulse modulation signal...

Claim 1 relates to the impulse modulation system where the impulse modulation is broken into the multiple subcarriers. Specifically, the subcarriers have the same data and are transmitted in a frequency range of the frequency band of the impulse modulation signal. This configuration allows corrupted subcarriers to be filtered out and non-corrupted subcarriers to be demodulated. Support for this feature is found in the originally filed application in at least Fig. 12 and on page 7, line 9 - page 8, line 12 of the specification. No new matter has been added.

Fullerton discloses an ultrawide-band transmission that is generated by impulse modulation. Specifically, Fullerton turns the impulse signal into multiple channels by use of subcarriers. Specifically, by using separate subcarriers at individual channels, communication over multiple independent channels is possible. This is supported in at least Fullerton's abstract ("*Subcarriers of different frequencies or waveforms can be used to add channelization of impulse radio signals. Thus, an impulse radio link can communicate many independent channels simultaneously by employing different subcarriers for each channel*"). Fullerton's system, however, is a broadband system that does not band limit the subcarriers in the frequency range of the impulse modulation signal. This is shown in Fullerton's transmission energy spectrum in Fig. 4 where the signals are not band limited. Fullerton goes on to teach that different data sources are being modulated with multiple subcarriers in Col. 18, lines 26-44 ("*voice information source ... digital data source ... digital control information source*"). Fullerton, however, does not teach a filter section that outputs a plurality of subcarriers that are in a frequency range of the frequency band of the impulse modulation signal (band limited).

On page 5, the Official Action states that Fullerton does not teach multiple subcarriers including the same data in the transmission signal. The Official Action goes on to state that Rouquette in Col. 1, lines 39-48 suggests multiple subcarriers having the same data ("*where the same data is transmitted over different physical paths interleaved in time in particular over different transmit and/or receiving antenna elements*"). Specifically, Rouquette features transmitting these signals from different transmit antennas at different times in different bands. Rouquette, however, does not teach that the plurality of subcarriers are filtered by a filter section in a frequency range of an impulse modulated signal.

Applicants' claim 1 is different than Fullerton and Rouquette, because subcarriers are modulated with the same data and a filter section band limits these transmission signals in a frequency range that is in the frequency band of the impulse modulated signal ("*a modulation part for generating a plurality of subcarriers modulation signals, at least two of the subcarriers including the same data, using an impulse modulation signal ... a filter section for outputting a plurality of transmission signals in a frequency range of the frequency band of the impulse modulation signal*"). Support for the band limiting filter section can be found on at least page 14, lines 23-27 ("*the signal outputted from the transmission section 205 is band-limited ... the filter section 250 has a pass characteristic assumably configured as shown in Fig. 3*"). Specifically, as shown in Fig. 3, Applicants have seven subcarriers that are multiplexed in frequency and band-limited. The subcarriers are generated within a specific frequency band as shown as the dashed line in Fig. 3. By band-limiting the subcarriers in the frequency band of the impulse modulated signal, the system can sustain reliable communication even if an interfering wave exists in the band. Certain subcarriers may be excluded when they are corrupted by an interfering wave as shown in Fig. 12. Specifically, in Fig. 12, subcarriers F4 and F5 are excluded in the demodulation since they are corrupted by interfering wave 1202. The remaining subcarriers are used to correctly demodulate the data.

Applicants include the feature of "*a modulation part for generating a plurality of subcarriers modulation signals, at least two of the subcarriers including the same data, using an impulse modulation signal ... a filter section for outputting a plurality of transmission signals in a frequency range of the frequency band of the impulse modulation signal*", that the following advantages are achieved. An advantage is the ability to utilize the subcarriers that are not deteriorated due to interfering waves and filtering those carrier waves which are deteriorated by interfering waves. This is accomplished by band-limiting the subcarriers in a frequency band of the impulse modulated signal. Accordingly, for the reasons set forth above, claim 1 is patentable over the art of record.

The Examiner rejects some other independent claims based on combinations of Fullerton, Rouquette, Aslanis (U.S. Publication No. 2002/0094049), Fullerton (U.S. Patent No. 5,687,169) and Toshimitsu (U.S. Patent No. 6,735,256). Neither of these references, however, suggest a filter section that band-limits the plurality of subcarriers in a frequency range of the impulse modulated signal as currently recited in Applicants' claim 1. Thus, neither of these references nor any of their combinations suggest the features in Applicants' claim 1.

Independent claim 32 has been similarly amended to claim 1, thus, claim 32 is also patentable over the art of record for the reasons set forth above.

Dependent claims 2-31 and 33-35 include all of the features of claims from which they depend. Thus, these claims are also patentable over the art of record for at least the reasons set forth above.

In view of the amendments and arguments set forth above, the above-identified application is in condition for allowance which action is respectfully requested.

Respectfully submitted,

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